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United States Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Subject: Licensee Event Report (LER) 454-2002-003-00, "Two Automatic Reactor Trips Due to Reactor Coolant Overtemperature Conditions Caused By Digital Electrohydraulic Control System Circuit Card Failure causing the Turbine Governor Valves to Close"

Byron Station, Unit 1
Facility Operating License No. NPF-37
NRC Docket No. STN 50-454

Enclosed is an LER involving the October 15, 2002 and November 7, 2002, reactor trips. The reactor trips are reportable to the NRC in accordance with 10 CFR 50.73 (a)(2)(iv).

Should you have any questions concerning this matter, please contact Mr. William Grundmann, Regulatory Assurance Manager, at (815) 406-2800.

Respectfully,

Richard Lopriore
Site Vice President
Byron Nuclear Generating Station

Attachment LER 454-2002-003-00

cc: Regional Administrator, Region III, NRC
NRC Senior Resident Inspector– Byron Station

IE22

NRC FORM 366 (7-2001)	U.S. NUCLEAR REGULATORY COMMISSION	APPROVED BY OMB NO. 3150-0104 EXPIRES 7-31-2004
LICENSEE EVENT REPORT (LER)		Estimated burden per response to comply with this mandatory information collection request. 50 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records Management Branch (T-6 E6), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to bjs1@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202 (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
Byron Station, Unit 1	05000454	1 OF 5

4. TITLE Two Automatic Reactor Trips Due to Reactor Coolant Overtemperature Conditions Caused by Digital Electrohydraulic Control System Circuit Card Failure Causing the Turbine Governor Valves To Close

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MO	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MO	DAY	YEAR	FACILITY NAME	DOCKET NUMBER 05000
10	15	2002	2002	003	00	12	13	2002	FACILITY NAME	DOCKET NUMBER 05000

9. OPERATING MODE: 1	11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply)			
10. POWER LEVEL: 100	20.2201(b)	20.2203(a)(3)(ii)	50.73(a)(2)(ii)(B)	50.73(a)(2)(ix)(A)
	20.2201(d)	20.2203(a)(4)	50.73(a)(2)(iii)	50.73(a)(2)(x)
	20.2203(a)(1)	50.36(c)(1)(i)(A)	x 50.73(a)(2)(iv)(A)	73.71(a)(4)
	20.2203(a)(2)(i)	50.36(c)(1)(ii)(A)	50.73(a)(2)(v)(A)	73.71(a)(5)
	20.2203(a)(2)(ii)	50.36(c)(2)	50.73(a)(2)(v)(B)	OTHER Specify in Abstract below or in NRC Form 366A
	20.2203(a)(2)(iii)	50.46(a)(3)(ii)	50.73(a)(2)(v)(C)	
	20.2203(a)(2)(iv)	50.73(a)(2)(i)(A)	50.73(a)(2)(v)(D)	
	20.2203(a)(2)(v)	50.73(a)(2)(i)(B)	50.73(a)(2)(vii)	
	20.2203(a)(2)(vi)	50.73(a)(2)(i)(C)	50.73(a)(2)(viii)(A)	
	20.2203(a)(3)(i)	50.73(a)(2)(ii)(A)	50.73(a)(2)(viii)(B)	

12. LICENSEE CONTACT FOR THIS LER

NAME	TELEPHONE NUMBER (Include Area Code)
William Grundmann, Regulatory Assurance Manager	(815) 406-2800

13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX
X	TG	PMC	Westinghouse	Y					

14. SUPPLEMENTAL REPORT EXPECTED		15. EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE)	x NO				

16. ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)

On October 15, 2002, at approximately 1217 hours, the Unit 1 reactor automatically tripped due to a Reactor Coolant (RC) overtemperature condition. The immediate cause of the RC overtemperature condition was the turbine governor valves closing causing a loss of turbine load. A malfunction in the Digital Electrohydraulic Control (DEHC) System was apparent, however thorough diagnostic testing could not identify any problems with the DEHC system. Four circuit cards with a high probability of causing this type of malfunction were replaced and the unit was restarted with additional monitoring equipment. On November 7, 2002 at approximately 1247 hours, the Unit 1 reactor again automatically tripped due to a RC overtemperature condition. The investigation revealed a very similar scenario between the previous trip and this trip. However, immediate indications and subsequent diagnostic testing of the DEHC system this time revealed a failure of the Bit Logic (BL3) circuit board in the DEHC computer. The cause of both reactor trips is attributed to this malfunctioning Bit Logic (BL3) circuit board in the DEHC computer. The circuit board malfunction was intermittent in nature and could not be diagnosed for the first reactor trip. The failure of the board was due to a single chip, type SN74H60. The cause of the failure of the chip is not determined at this time. The DEHC system computer's BL3 card was replaced. Further analysis will be conducted on the failed chip to determine the cause of the failure. There were no safety consequences impacting plant or public safety as a result of these events. The unit is designed to cope with a loss of turbine load event. In both trips, the reactor trip system functioned as designed and shut down the reactor without incident. These events are reportable to the NRC in accordance with 10 CFR 50.73 (a)(2)(iv).

A. Plant Conditions Prior to Event:

First Reactor Trip

Event Date/Time: October 15, 2002 / 1217 hours

Unit 1, Mode 1 – Power Operations, Reactor Power – 100%

Reactor Coolant (RC) [AB] System - Normal Operating Temperature and Pressure

No structures, systems or components were inoperable at the start of the event that contributed to the event.

Second Reactor Trip

Event Date/Time: November 7, 2002 / 1247 hours

Unit 1, Mode 1 – Power Operations, Reactor Power – 100%

Reactor Coolant System - Normal Operating Temperature and Pressure

No structures, systems or components were inoperable at the start of the event that contributed to the event.

All times referred to in this report are Central Standard Time.

B. Description of Event:

The Turbine is equipped with a Digital Electrohydraulic Control (DEHC) [TG] System consisting of a solid-state electronic controller and a high pressure fluid supply used for control of the turbine valve operators. The controller compares signals representing turbine speed and first stage pressure with reference values initiated by a load demand signal. The controller then puts out a comparison signal that actuates hydraulic control of the main turbine governor valves to match generator output to load demand.

First Reactor Trip

On October 15, 2002, at approximately 1217 hours, the Unit 1 reactor automatically tripped due to a RC overtemperature condition. The immediate cause of the RC overtemperature condition was the turbine governor valves closing causing a loss of turbine load. The Operators observed the Main Generator electrical output drop from 1282 to 232 megawatts. Licensed Operators appropriately responded to the reactor trip. The loss of turbine load resulted in an increase in both RC pressure and temperature. The Pressurizer Spray Valves and Power Operated Relief Valves (PORVs) automatically opened, as

B. Description of Event (continued):

expected. The temperature increase in the RC and the corresponding RC pressure decrease by the PORVs opening caused the setpoint for the automatic reactor protection function of Overtemperature Delta Temperature (OTDT) to be reached and the reactor tripped as expected. The Main Steam [SB] dumps and steam generator PORVs opened appropriately in response to the secondary pressure increase from the governor valves going closed. The 1A RC pump was energized via the unit auxiliary transformer due to surveillance testing of its normal electrical feed and consequently lost power when the turbine tripped. A Unit Operator (licensed) observed RC pressure decreasing towards the Safety Injection setpoint and took action to manually close the Pressuizer PORVs in advance of the automatic reclosure signal. The 1A and 1B Auxiliary Feedwater (AF) [BA] Pumps were manually started.

A root cause investigation was initiated. All causes for an RC overtemperature condition were ruled out except for DEHC system. A malfunction in the DEHC system was apparent due to an unusual display on the DEHC system panel in the Main Control Room and several distorted parameters. However, thorough diagnostic testing did not identify any problems with the DEHC system and extensive testing could not recreate the failure. A review of the data from the computer that tracks the DEHC system showed that all three speed channels went to zero in the DEHC system at the start of the event. The DEHC system responded by sending a close signal to the governor valves, which responded normally. Within 10 seconds, the governor valves were closed which caused a loss of load. Approximately 55 seconds into the event the DEHC system computer reset itself and most of the data began to appear correct.

The investigation identified four circuit cards in the system that would be the most likely cause of the event. These four cards were replaced. A monitoring computer was installed to save additional data points from the DEHC system computer. Under this continuous monitoring of the DEHC system, the unit was restarted with no indications of abnormal conditions on the DEHC system.

Second Reactor Trip

On November 7, 2002 at approximately 1247 hours the Unit 1 reactor again automatically tripped due to a RC overtemperature condition. Licensed Operators appropriately responded to the reactor trip. The immediate cause of the RC overtemperature condition was the turbine governor valves closing causing a loss of turbine load. As with the first trip, the plant responded as expected. The Pressurizer Spray valves and Power Operated Relief Valves (PORVs) automatically opened, as expected. The temperature increase in the RC and the corresponding RC pressure decrease created by the PORVs opening caused the setpoint for the automatic reactor protection function OTDT to be reached and the reactor tripped as expected. The Main Steam dumps and steam generator PORVs opened appropriately in response to the secondary pressure increase from the governor valves going closed. The 1B AF pump automatically started on expected low steam generator level. The 1A AF pump was manually started prior to the low level setpoint being reached. A review of the data from the plant process computer and the special monitoring computer set up after the last reactor trip indicated a very

B. **Description of Event (continued):**

similar scenario between the previous trip and this trip. As in the original event, some of the DEHC system computer data showed some incorrect data as compared with non-DEHC system based plant data. This led investigators to believe that the data again had been corrupted. The same unusual display of the DEHC panel in the MCR was noted. However, the data remained incorrect and the computer did not reset itself. The special monitoring computer was found locked up after the event. A review of the data indicated that it had stopped collecting data prior to the event. However, immediate indications and subsequent diagnostic testing of the DEHC system this time revealed a failure of one of the 8 cards in the Central Processing Unit (CPU). The card is a Bit Logic (BL3) circuit board in the DEHC system computer's CPU.

This BL3 card was then taken to the DEHC system simulator where the failure was repeated. This confirmed a hard failure had occurred that was repeatable.

An Emergency Notification System (ENS) notification for the first reactor trip and manual starts of the 1A and 1B AF pumps at 1432 hours on October 15, 2002 and the ENS notification for the second reactor trip and automatic start of the 1B AF pump and the manual start of the 1A AF pump was made at 1347 hours. These events are also require an LER in accordance with 10 CFR 50.73 (a)(2)(iv).

C. **Cause of Event:**

At the time of the first reactor trip the cause was indeterminate. Circuitry within the CPU was not suspected since it was operating normally and it was believed that a failure in the CPU would lock it up. The cause of the second reactor trip and, in retrospect, the first reactor trip is attributed a malfunctioning Bit Logic (BL3) circuit board in the DEHC computer CPU. The circuit board malfunction was intermittent in nature and could not be diagnosed for the first reactor trip. The failure of the board was due to a single chip, type SN74H60. The cause of the failure of the chip was not determined at this time. This card is one of an eight-card set that makes up the Arithmetic and Control portion of the Westinghouse DEHC Mod II Mark III Computer.

D. **Safety Analysis:**

There were no safety consequences impacting plant or public safety as a result of these events. The unit is designed to cope with a loss of turbine load event. In both trips, the reactor trip system functioned as designed and shut down the reactor without incident. The 3rd quarter 2002, Unit 1 NRC performance indicator for unplanned scrams per 7000 critical hours is in the green band at a value of zero. With these two reactor trips in the 4th quarter 2002 it is expected the Performance Indicator will remain in the green band.

E. Corrective Actions:

First Reactor Trip

Four circuit cards with a high probability of causing this type of malfunction in the DEHC system were replaced. The removed cards were inspected for visible damage and sent to a lab for diagnostic testing. No defects were found on the cards.

A special monitoring computer was installed to monitor performance of the DEHC system.

Second Reactor Trip

The DEHC system CPU BL3 card was replaced. Subsequent diagnostic testing of the DEHC system was performed with no failures. Further analysis will be conducted on the failed chip to determine the cause of the failure. Following this analysis, further corrective actions will be determined, as appropriate.

Further evaluation will be conducted to determine the cause of special monitoring computer failure to yield data on second event.

F. Previous Occurrences:

None

G. Component Failure Data:

Manufacturer	Nomenclature	Model Number
Westinghouse	Bit Logic Card	N/A